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☐ 1. Document ID: US 20010045360 A1 KR 2001107788 A CA 2349156 A1 EP 1164208 A2 JP 2002121699 A CN 1335419 A

L1: Entry 1 of 1

File: DWPI

Nov 29, 2001

DERWENT-ACC-NO: 2002-066028

DERWENT-WEEK: 200236

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TITLE: Electroplating of plating target articles involves utilizing combination of vibrational flow in plating bath and plating current of pulse

INVENTOR: OMASA, R

PRIORITY-DATA: 2001JP-0129994 (April 26, 2001), 2000JP-0155046 (May 25, 2000), 2000JP-0243249 (August 10, 2000)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
US 20010045360 A1	November 29, 2001		031	C25D005/18
KR 2001107788 A	December 7, 2001		000	C25D005/18
CA 2349156 A1	November 25, 2001	E	000	C25D005/18
EP 1164208 A2	December 19, 2001	E	000	C25D005/08
JP 2002121699 A	April 26, 2002		018	C25D021/10
CN 1335419 A	February 13, 2002		000	C25D005/18

INT-CL (IPC): C25 D 5/08; C25 D 5/18; C25 D 5/54; C25 D 7/00; C25 D 7/12; C25 D 17/00; C25 D 17/16; C25 D 21/10; C25 D 21/12; H01 L 21/288

Full	Title	CIT.1	REV.1	CLS.1	REF.1	SEQ.1	ATT.1
CAW.1							

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Terms	Documents
2001ep-0112689.ap.	1

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Document ID: EP 1164208 A2	Pages: 33	U	S	C	P	Kind Codes	Source
							EPO

PUB-NO: EP001164208A2

DOCUMENT-IDENTIFIER: EP 1164208 A2

TITLE: ELECTROPLATING method using combination of vibrational flow in plating bath and plating current of pulse

PUBN-DATE: December 19, 2001

INVENTOR-INFORMATION:

NAME: OMARA, RYUSHIN

COUNTRY: JP

ASSIGNEE-INFORMATION:

NAME: JAPAN TECHNO CO LTD

COUNTRY: JP

APPL-NO: EP01112689

APPL-DATE: May 25, 2001

PRIORITY-DATA: JP2000155046A (May 25, 2000), JP2000243249A (August 10, 2000), JP2001125994A (April 26, 2001)

INT-CL (IPC): C25D005/08, C25D005/18, C25D021/10, C25D017/00

ABSTRACT:

CHG DATE=20020103 STATUS=O In an electroplating method, a plating target article (X) disposed so as to be in contact with plating bath (14) is set as a cathode while a metal member disposed so as to be in contact with the plating bath (14) is set as an anode, and a voltage is applied between the cathode and the anode while vibrational flow is induced by vibrating vibrational means (16) which are fixed in multi-stage style to a vibrating rod (16) vibrating in the plating bath (14) interlockingly with vibration generating means (16d). Electing current flowing from the anode through the plating bath (14) to the cathode is pulsed and alternately set to one of a first state where the plating current keeps a first value I1 for a first time T1 and a second state where the plating current keeps a second value I2 having the same polarity as the first value I1 for a second time T2, the first value I1 being five or more times larger than the second value I2, and the first time T1 being three or more times longer than the second time T2. <IMAGE>

Europäische Patentsamt
European Patent Office
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EUROPEAN PATENT APPLICATION

EP 1 164 208 A2

(12) Date of publication:
16.12.2001 Bulletin 2001/51

(51) Int. Cl.: C25D 6/08, C25D 6/18,
C25D 21/10, C25D 17/00

(21) Application number: 01112689.3

(22) Date of filing: 25.05.2001

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR
Designated Extending States:
AL LT LV MK NO SI

(71) Applicant: Japan Techno Co., Ltd.
Tokyo (JP)

(72) Inventor: Omara, Ryushin
Fujisawa-shi, Kanagawa (JP)

(30) Priority: 25.05.2000 JP 2000155046
10.08.2000 JP 2000243249
26.04.2001 JP 2001125994

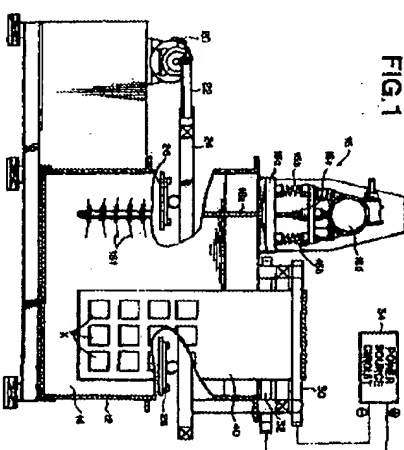
(74) Representative: Gervasi, Gemma, Dr. et al.
Notarbartolo & Gervasi S.p.A., Corso di Porta
Vercellese, 9
20122 Milano (IT)

(54) Electroplying method using combination of vibrational flow in plating bath and plating current of pulse

(57) In an electroplating method, a plating target article (X) disposed so as to be in contact with plating bath (14) is set as a cathode while a metal member disposed so as to be in contact with the plating bath (14) is set as an anode, and a voltage is applied between the cathode and the anode while vibrational flow is induced by vibrating vibrational means (16) which are fixed in multi-stage style to a vibrating rod (16) vibrating in the plating bath (14) interlockingly with vibration generating means

(16d). Plating current flowing from the anode through the plating bath (14) to the cathode is pulsed and alternately set to one of a first state where the plating current keeps a first value I1 for a first time T1 and a second state where the plating current keeps a second value I2 having the same polarity as the first value I1 for a second time T2, the first value I1 being five or more times larger than the second value I2, and the first time T1 being three or more times longer than the second time T2.

FIG. 1



EP 1 164 208 A2

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- L5: (758) (electrolytic or electrochemical) near deposits
- L8: (17868) 12 or 15
- L11: (201285) pulse or pulses or pulsed or pulsing
- L14: (9477) pulsation or pulsations or pulsating
- L17: (209643) 111 or 114
- L20: (706535) current or voltage
- L23: (24409) 117 near 120
- L26: (126) 18 and 123
- L29: (22386) vane or vanes
- L32: (1) 126 and 129
- L35: (3417) vibrate or vibrates or vibrated or vibrating
- L36: (131488) vibration or vibrations vibrational
- L41: (148088) 135 or 138
- L43: (2) 126 and 141
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Doc: EPO JP
 Def: JP
 Def: JP
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 Def: JP

126 and 141

U	I	P	Document ID	Issue Date	Pages	Title	Current OR	Current Xref	Retrieval C	Inventor	S	C	2	3	4	5	6	7	8	9	0
			JP 63312996 A	19881221	2	METHOD FOR ELECTRODEPOSITING AMORPHOUS ALLOY				MATANABE, SHUNJI et al.											
			EP 1164208 A2	20011219	33	Electroplating method using combination of vibrational				OMASA, RYUSHIN											

As US item

As JP item

As EP item

As IT item

As CN item

☐ Drafts

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☐ L1: (268) (205/148).CCL8.

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☐ L4: (991368) current or voltage

☐ L5: (388475) 12 or 13

☐ L6: (82453) 15 near3 14

☐ L7: (15) 11 and 16

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☐ L1 and L6

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1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 6251250 B1	20010626	17	Method of and apparatus for controlling fluid flow and	205/89	204/224R;		Keigler, Arthur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 6235181 B1	20010522		Method of operating process for anodizing valve metals	205/148	205/234;		Kinard, John T. et al.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 6132587 A	20001017		Uniform electroplating of wafers	205/123	204/224R;		Jorne, Jacob et al.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 5958604 A	19990928		Electrolytic process for cleaning and coating	428/612	205/102;		Riabkov, Vitaliy M. et al.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 5911863 A	19990615		Method of manufacturing plastic foils which are	205/103	205/131;		Vetter, Johann et al.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 5700366 A	19971223		Electrolytic process for cleaning and coating	205/87	205/102;		Steblianko, Valerij	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 5584983 A	19961217		Method for the production of a metal foam	205/103	205/131;		Leonievich et al.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 5518605 A	19960521		Method of nitriding ferrous metal parts having improved	205/148	205/104;		Hadj-Rabah, Hocine et al.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 4898647 A	19900206		Electroplating copper foil	205/108	204/216;		Luce, Betty M. et al.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 4855020 A	19890808		Apparatus and method for electroplating	205/137	204/212;		Sirbule, Michael A.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 4652348 A	19870324		Method for the production of alloys possessing high pulse electrodepositing	205/101	204/DIG. 9;		Yahalom, Joseph et al.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	US 4496436 A	19850129		Method	205/83	205/DIG. 9;		Inoue, Kiyoshi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5/2003 SN 09/864,650 line 13

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112 and 16

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U	I	PT	P	Document ID	Issue Date	Pages	Title	Current OR	Current XREF	Retrieval C	Inventor	B	C	2	3	4
1				US 6368482 B1	20020409	27	Plating processes utilizing high intensity acoustic	205/91	204/222; 204/273;		Oettinger, Richard C. et al.					
2				US 6277265 B1	20010821		Apparatus and method for electrocoriolis, the	205/687	204/242; 204/267;		Hanek, Joseph J.					
3				US 6261433 B1	20010717		Electro-chemical deposition system and method of	205/96	204/230.2; 204/230.7;		Landau, Uziel					
4				US 6251250 B1	20010626	17	Method of and apparatus for controlling fluid flow and	205/89	204/224R; 204/230.2;		Keigler, Arthur					
5				US 5858199 A	19990112		Apparatus and method for electrocoriolis the	205/687	204/267;		Hanek, Joseph J.					
6				US 5173169 A	19921222		Electroplating method and apparatus	205/91	204/222; 204/273;		Garrison, Alexander J. et al.					
7				US 4584081 A	19860422		Apparatus for depositing metal on the rubbing parts	204/272	204/273;		Coulon, Andre					
8				US 4368106 A	19830111		Implantation of electrical feed-through conductors	205/123	204/277; 205/125;		Anthony, Thomas R.					
9				US 4329209 A	19820511		Process using an oxidant depolarized solid polymer	205/512	204/273; 204/222;		Johnson, Harlan E.					
10				US 4316786 A	19820223		Apparatus for electroplating particles of small dimension	204/223	204/229.4; 204/273;		Yu, Conrad M. et al.					
11				US 4201635 A	19800506		Method and apparatus for carrying out an electrolysis	205/339	204/212; 204/230.2;		Muller, Klaus					
12				US 3652442 A	19720328		ELECTROPLATING CELL INCLUDING MEANS TO ACTUATE	204/273	204/261		Powers, John V. et al.					

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126 and 129

combination of vibrational



5/2003 SN 09/864,650

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File Edit View Window Help

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11 and 12

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	U	I	PT	P	Document ID	Issue Date	Pages	Title	Current OR	Current XREF	Retrieval C	Inventor	S	C	2	3	4	5	6	7	8	9	10	11	12
1					US 6261435 B1	20010717	18	Plating method	205/205	205/137;		Omase, Ryushin													
2					US 6251250 B1	20010626		Method of and apparatus for controlling fluid flow and	205/89	204/224R;		Reigler, Arthur													
3					US 6221437 B1	20010424		Heated workpiece holder for wet plating bath	427/430.1	205/146;		Reynolds, H. Vincent													
4					US 6077412 A	20000620		Rotating anode for a wafer processing chamber	205/143	204/212;		Ting, Chiu H. et al.													
5					US 5904827 A	19990518		Plating cell with rotary wiper and megasonic	205/68	204/263;		Reynolds, H. Vincent													
6					US 5683564 A	19971104		Plating cell and plating method with fluid wiper	205/68	204/212;		Reynolds, H. Vincent													

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Document ID	Pages	U	S	C	P	Kind Codes	Source
US 6261435 B1	18						USPAT
US 6251250 B1	17						USPAT
US 6221437 B1	7						USPAT
US 6077412 A	25						USPAT
US 5904827 A	10						USPAT
US 5683564 A	11						USPAT

US-PAT-NO: 6261435

DOCUMENT-IDENTIFIER: US 6261435 B1
See Image for Certificate of Correction

TITLE: Plating method

KNIC

Brief Summary Text - BSMX (18):

In the plating method as described above, the treatment bath is vibrationally stirred by vibrating a vibration yoke at an amplitude (width of vibration) range from 0.5 to 3.0 mm and at a vibrational frequency of 200 to 800 times per minute; the reaction is performed by using air bubbles generated by a diffuser pipe having a pore opening of 200 to 400 μ m; the plating target is swung at an amplitude (width of swing) of 10 to 100 mm and at a swing frequency of 10 to 30 times per minute; and the plating target is vibrated at an amplitude of 0.5 to 1.0 mm and at a vibrational frequency of 100 to 300 times per minute.

Brief Summary Text - BSMX (20):

In the plating method as described above, the vibrationally stirring apparatus for the treatment bath preferably includes vibration generating means containing a vibration motor, vibrationally stirring means for vibrating at an amplitude of 0.5 to 3.0 mm and at a vibrational frequency of 200 to 800 times per minute a vibration yoke which is fixed in one stage or in multistage to a vibrating bar which interlocks with the vibration generating means to vibrate in a treatment tank, an inverter for controlling the vibration motor to generate any low-frequency vibration at any frequency in the range from 10 to 500 Hz; preferably from 30 to 60 Hz, and more preferably from 30 to 40 Hz, and vibration stress dispersing means at a connection portion of the vibration generating means and the vibrationally stirring means.

Drawing Description Text - DDMX (8):

FIG. 7 is an enlarged partial cross-sectional view showing a manner of fixing vibration yokes to a vibration bar;

Detailed Description Text - DDMX (10):

In FIGS. 4 and 5, on each vibrating bar 16, a spacer 30 is positioned between the neighboring vibration yokes 17 so that the yokes each held by a pair of vibration yokes fixing members 18 are positioned at a certain interval.

Detailed Description Text - DDMX (11):

The vibration yoke 17 is preferably formed of thin metal, elastic synthetic resin, rubber or the like, and the thickness thereof may be set so that at least the tip portion of the yoke plate shows a flutter phenomenon (as if it is curved) by the vertical oscillation of the vibration motor 4, whereby the

United States Patent Omaha

(10) Patent No.: US 6,261,435 B1
(45) Date of Patent: Jul. 17, 2001

PLATING METHOD

(75) Inventor: Ryusaku Omaha, Fujiwara (JP)
(73) Assignee: Nihon Techno Kabushiki Kaisha, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(d) by 0 days.

(21) Appl. No.: 09/062,125

(22) Filed: Apr. 17, 1998

(30) Foreign Application Priority Data
Oct. 21, 1997 (JP) 9-306629

(31) Int. Cl.⁷ C25D 5/34; C25D 5/00; C25D 5/20; B05D 3/04; B05D 3/12

(32) U.S. Cl. 205/205; 205/137; 205/148; 205/204; 427/364; 427/346

(33) Field of Search 427/36; 205/148; 137; 205; 920

FOREIGN PATENT DOCUMENTS

- (56) References Cited
- 2066762 * 5/1990 (CA)
- 55-3633 1/1975 (JP)
- 56-42998 4/1981 (JP)
- 58-18395 4/1983 (JP)
- 62-32893 5/1986 (JP)
- 61-46459 10/1986 (JP)
- 62-154797 7/1987 (JP)
- 3-204497 12/1991 (JP)
- 3275130 12/1991 (JP)
- 6-71544 12/1992 (JP)
- 5-506716 12/1992 (JP)
- 5-209306 * 10/1994 (JP)

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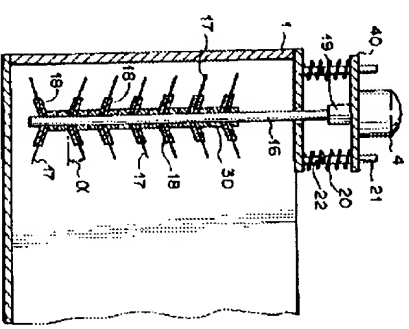
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Nihon Kogyo Shimbun Co., Ltd., "Plating Technique Handbook", Jul. 25, 1991.
English language abstract for Sho-57-47192, corresponding to 61-46339 Oct. 15, 1986.
English language abstract for Hei-3-75130, corresponding to 6-71544 Dec. 5, 1991.
Communication and European Search Report No. EP 98 10 7707 dated Jan. 28, 1999.
* cited by examiner

Primary Examiner—Edna Wong
(74) Attorney, Agent, or Firm—Pitney, Hardin, Kipp & Smith LLP

ABSTRACT

In a plating method for successively treating a plating target from a pre-treatment step until a plating treatment, (A) a vibrationally stirring apparatus for a treatment bath, (B) an excitation apparatus for the treatment bath, (C) an apparatus for swinging an electrode bar for suspending the plating target therein, and (D) an apparatus for applying vibration to the electrode bar, are operated in a cleaning tank and at least one of an electrolysis plating tank and an electroplating tank used as a treatment tank in the pre-treatment step and the plating step.

13 Claims, 7 Drawing Sheets



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US-PAT-NO:      6322689
DOCUMENT-IDENTIFIER:  US 6322689 A1
TITLE:          Anodizing method and apparatus for performing the same
----- RWIC -----

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Brief summary Text - BSTX (13):

(a) a step of vibrationally fluidly stirring the treatment bath, wherein the treatment bath is vibrationally fluidly stirred by vibrating a vibration vessel at an amplitude from 0.5 to 3.0 mm and at a vibrational frequency of 200 to 8000 times per minute; and

Brief summary Text - BSTX (19):

(A) a vibrationally fluidly stirring apparatus for the treatment bath, which comprises a vibration generating means containing a vibration motor, a vibrationally fluidly stirring means for vibrating a vibration γ at an amplitude of 0.5 to 3.0 mm and at a vibrational frequency of 200 to 800 times per minute to generate vibrational flow in the treatment bath, the vibration γ being fixed in one stage or in multi-stage to a vibrating bar which vibrates in the treatment bath interlocking with the vibration generating means, and a vibration stress dispersing means at a connection portion of the vibration generating means and the vibrationally fluidly stirring means; and

Brief Summary Text - BSTX (44) :

In the method of the present invention, a post-treatment process may be performed as usual after the anodizing treatment process. Example of the post-treatment process comprises a sealing step for treating the porous surface of the metal body. The sealing step can be performed by steam sealing, metal salt sealing, silicate/sealant solution sealing, dye sealing, or pigment sealing, or, the combination thereof.

Drawing Description Text - DRTX (11):

FIG. 10 is an enlarged cross-sectional view showing a manner of fixing the vibration ~~bar~~ to a vibration bar;

Detailed Description Text - DETX (3):

IN FIGS. 1 to 3, the aeration apparatus (B) includes three diffusing pipe 12 disposed on the bottom plate of the treatment tank 1, and compressed air inlet ports 10 through which compressed air is fed to the diffusing pipes 12. Reference numeral 4 denotes a vibration motor, 16 a vibrating bar, 17 a vibration yoke, and 18 a vibrationally fluidly connecting member connecting the apparatus (A).

Detailed Description Text - DDTX (5):

United States Patent
(12)
Omasa

(10) Patent No.: US 6,322,689 B1
(45) Date of Patent: Nov. 27, 2001

(54) ANODIZING METHOD AND APPARATUS FOR PERFORMING THE SAME

FOREIGN PATENT DOCUMENTS

(75) **inventor: Ryushin Omura, Fujisawa (JP)**

(73) Assignee: Japan Techno Co., Ltd. (JP)

(*) Notice: Subject to any disclaimer, the term of this

U.S.C. 1540b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appi. No.: 09/536,844

(22) Filed: MAR. 29, 2000

(30) Foreign Application Priority Data

APR 21 1999 (JF) 117-9000

(52) U.S. CI. 205/324; 205/336; 205/323

(58) Field of Search 204/222, 273

205/6/1, 324, 310-333.

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Abstract from Brezina Application No. JP-000835-6A, published Oct. 24, 1995.
Abstract XWO141496 from Isopacac Application JP S-000840-A dated Jun. 7, 1979.
* cited by examiner

Primary Examiner—Robert Dawson
Assistant Examiner—Michael, Peely
(74) *Attorney*: Agost, or Firm—Flitney, Hardin, Kipp & Smith, LLP

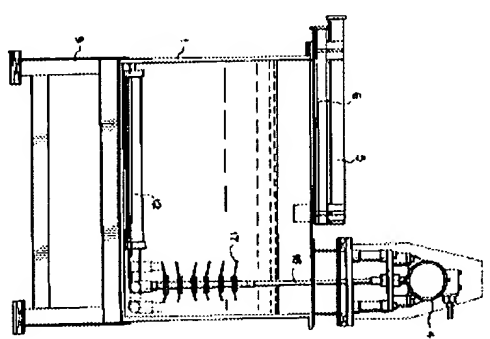
(57) **ABSTRACT**

A smoking method of a mental body which includes an acidizing treatment process performed while vibrationally excited and emitting a treatment bath in which the mental body is vibrated and swung and an apparatus for performing the same.

19 Claims, 14 Drawing Sheets

(57) **ABSTRACT**

An amazing method of a metal body which induces an associating treatment process performed while vibrationally stirring and drying a treatment bath in which the metal body is vibrated and swung and an apparatus for performing the same.





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- L2: (48961) vane or vanes
- L3: (6) 11 and 12
- L4: (70421) vibrate or vibrates or vibrated or vibrati
- L5: (184265) vibration or vibrations or vibrational
- L6: (211397) 14 or 15
- L7: (22) 11 and 16
- L8: (122) (205/104).CCUS.
- L9: (0) 18 and 12
- L10: (11) 18 and 16
- L11: (424) (204/273).CCUS.
- L12: (31937) electroplating or electrodeposits
- L13: (3397) (electrolyticals or electrochemicals) near
- L14: (33696) 112 or 113
- L15: (125) 111 and 114
- L16: (16) 115 and 12
- L17: (29) 115 and 16
- L18: (19) 117 not (13 or 17 or 116)

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117 not (13 or 17 or 116)

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[illegible]

FIG. 1 shows a typical waveform for pulsed deposition.

Detailed Description Text - DETX (15):

Measurements of the chromium content of the alloy at various pH values while also varying the temperature, using the chromium current efficiency as the dependent variable, showed that the efficiency goes through a minimum at about 55 degrees C. and at a pH of 2. At a temperature of 55 degrees C. and at a pH of 2, containing over 18 weight percent chromium, deposits are produced by direct current deposition. Significant improvements in deposit morphology are obtained by alternating current deposition, as discussed in greater detail hereinafter.

Detailed Description Text - DETX (16):

Direct current deposition using the plating bath of the invention produces surprisingly and unexpectedly thick nickel-chromium alloy deposits having advantageous morphological characteristics. Either direct or pulsed current deposition according to the process of the invention can give nickel-chromium deposits at least 25 microns thick, and coatings of thicknesses of at least 5 microns, 75 microns, 100 microns, and even 125 microns have been achieved.

Detailed Description Text - DETX (17):

Even better deposits can be obtained using aluminum current deposition. Initiating permits deposition of alloy compositions which cannot be obtained by direct current deposition. Moreover, it is possible to electrically control the coating composition and morphology by control of the aluminum current parameters.

Detailed Description Text - DETX (18):

In England electrodeposition, there are four variables that are of primary importance. These are: (1) Salina height (peak current density); (2) hose height (off time current density); (3) on time; and (4) off time.

Detailed Description Text - DETX (20) :

It had not been known previously how PbNiCr current deposition would affect the composition and the morphology of nickel-chromium electrodepositing alloys. The general theory of PbNiCr current deposition has shown that important effects on morphology and composition of the deposited metal coating can be affected by variation of the operating parameters. During the On Time, the production by variation of the operating parameters. During the On Time, the concentration of both nickel and chromium ions is reduced within a certain concentration distance from the cathode. This so-called diffusion layer coincides with the same frequency as the applied current. Its magnitude is also related to the peak current density of the ions involved. During the Off Time, the diffusion coefficient of the reactants builds up again and will reach the equilibrium concentration of the bulk electrolyte if enough time is allowed.

Detailed Description Text - DETX (21):

ings exceeded the wear performance of electrodeposited nickel.

The crest density, the Duty Cycle and the Period each have an effect on the deposit. Variation of current density for various Duty Cycles, using a fixed On-Time of 2 milliseconds, shows that chromium content increases as current density increases, for all Duty Cycles from 20 to 80% (FIG. 3). The higher the Duty Cycle, the higher the chromium content, for the same current density. Variation of the period in a fixed Duty Cycle of 20% and at various current densities resulted in variations of the chromium content (FIG. 3). Local reactions seen for periods in the millisecond range, that is, less than 10 milliseconds, are of zero, the

The γ is height can be positive, negative or zero, the latter being convenient for studying variations in other parameters. Negative base current density provides cathodic protection by reducing corrosion processes during Off Time. Positive base current density can be used to reduce surface roughening, especially when plating near the limiting current density of the system.

There is a significant difference in the surface morphology of alloy deposits produced with pulsed galvanostatic deposition, as a function of different wave-forms. In general, direct current deposit will produce a rougher surface than pulsed current deposition for the same current density. The Duty Cycle also affects the surface roughness, and it is generally the case that smoother deposits are produced at lower duty cycles. Also, shorter periods generally produce smoother coatings for the same Duty Cycle. Control of pH and temperature to keep these factors substantially constant will also produce a more uniform deposit.

For most pulsed electrodeposition applications it will be advantageous to set the relevant parameters in the following ranges:

Parameter	Broad	Narrow
Period (min)	0.05-10	0.1
Duty Cycle (%)	20-80	25-50
Current Density (A/cm ²)	5-100	25-50
Base Material (A/cm ²)	-10 ⁻¹ 10	0

It will be appreciated that the foregoing ranges are illustrative and not limitative of the broad scope of this invention. A wide range of variability is possible for the plated deposition process, permitting attractive control of the process and allowing the chroton content, the surface morphology and the layering of the deposit to be controlled. This in turn translates into significant control over the resultant properties of the alloy coating. Depending upon the ultimate use, the properties of greatest concern can be controlled to maximize the desired characteristics.

The electrodeposition process of the invention can be effected using standard cells and electrodes, e.g., rotating disc electrodes. Preferably, anodic reactions are minimized by the use of anodic/cathodic surface area ratios of at least 2/1, and by the use of low polarization rates. A nickel, nickel-chromium or platinum anode can be used, as can the usual commercial anodes, e.g., cadmium, graphite, platinum and titanium and the like. Anodic reactions are generally not important, but separate anodic and cathodic compartments can be used to prevent diffusion of anodic decomposition products into the cathode plating compartment. For example, semi-permeable membranes, e.g., Nafion membranes, can be used to separate the anodic and cathodic regions, spe-

cally when readily decomposable complexing agents, e.g., glycine, are used.

Without further elaboration, it is believed that one skilled in the art can, using the preceding description, utilize the present invention to its fullest extent. The following preferred specific embodiments are, therefore, to be construed as merely illustrative, and not limitative of the remainder of the disclosure in any way whatsoever. In the following examples, all temperatures are set forth uncorrected in degrees Celsius unless otherwise indicated, all parts and percentages are by weight.

EXAMPLE 1

Comparative Test of Throwing Power

The growing powers of a nitric bath according to the present invention and a nickel-chromium sulfate pre-bath according to U.S. Pat. No. 3,186,744 (Strommen) were compared under identical conditions in a 500 ml. beaker. The bath solutions were prepared in a standard Hull Cell, at 3 amps DC for 5 minutes. Each bath was prepared using standard shelf reagents and distilled water. The Strommen bath had the composition shown in Example I of the patent, 0.15 M $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$, 3 g/l. 24. The bath according to the present invention had 3 g/l. 24, and the composition:

Constituent	Amount
NaCl, 4H ₂ O	50 g/l
CaCl ₂ ·2H ₂ O	100 g/l
Formic Acid (95%)	40 ml/l
NaH	15 g/l
NH ₄ Cl	30 g/l
Boric Acid	30 g/l
Oxalic Acid	10 g/l
Sodium Citrate Dihydrate	50 g/l
Total N, 100 (100%)	1 decal.

This Stromatt bath pined out to a distance of 43 mm, while the bath according to the invention pined out to a distance of 71 mm with improved surface morphology, showing the significantly greater throwing power of the present bath.

EXAMPLE 2

Microhardness measurements were carried out with a Vickers indenter at the indicated load of 25 or 50 grams, using a calibrated standard periodically to insure proper operation of the instrument.

$\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$	30 g/l
$\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$	100 g/l
NaBr	13 g/l
$\text{Na}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$	80 g/l
(Sodium Oxalate Dihydrate)	
H_2BO_3	40 g/l
HCOOH (31%)	30 ml/l

Electrodeposition was effected at about 33° C. and at pH 3.5, with zero Amp Off Time current, in a Pyrex cell containing about 0.5 liter of electrolyte, using either platinum or high-purity carbon anodes. The samples were coated rotating disc electrodes about 1 cm in diameter. Other diameters, as well as other geometries, have also been used successfully.

5/2003 SN 09/864,650 line 5

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L1: (122) (205/104), CCLB.

L2: (377623) pulse or pulses or pulsed or pulsing

L3: (25679) pulsation or pulsations or pulsating

L4: (390558) 12 or 13

L5: (88) 11 and 14

L7: (33) 11 not 15

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History of items only

U	I	PT	P	Document ID	Issue Date	Pages	Title	Current OR	Current XRef	Retrieval C	Inventor	8	C	2	3	4	5
1				US 6547944 B2	20030415	9	Commercial plating of	205/96	205/102		Schreiber, Chris M. et al.						
2				US 6312579 B1	20011106	5	nanolaminates	205/95	205/103		Bank, Brian L. et al.						
3				US 5730852 A	19980324	8	Bearing having multilayer	205/192	205/104		Bhatnagar, Raghav N. et al.						
4				US 5156729 A	19921020	6	Preparation of coking gas	205/104	136/265		Mahrus, Duraud et al.						
5				US 5132200 A	19920721	6	(X=0-2, Y=0-2, Z=0-2, N=0-3)	205/104	205/149		Fukuda, Yuzuru et al.						
6				US 4849302 A	19890718	8	Method of making a plain	205/104	205/176		Ostwald, Robert						
7				US 4049507 A	19770920	4	bearing sliding layer	205/104	205/104		Tokumoto, Shin-ichi et al.						
8				US 4046643 A	19770906	21	Electrophotographic	205/103	204/273		Rippete, Ralph E.						
9				US 4032413 A	19770628	4	Electrodeposition method	205/103	205/104		Dotzer, Richard et al.						
10				US 4000046 A	19761228	9	Production of multi-metal	205/103	205/104		Weaver, Charles A.						
11				US 3909404 A	19750930	3	particles for powder	205/103	205/104		Boycott, William A.						
12				US 3804725 A	19740416	8	Electroplating bath and	205/103	204/229								
							method for the	205/103	204/229								
							conductive layer over an	205/103	204/229								
							composition and process for	205/103	204/229								
							electrodepositing a black	205/103	204/229								
							METHODS AND APPARATUS FOR	205/103	204/229								
							PREPARING AN ARTICLE	205/103	204/229								

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Phase: High school and the terms initially

- ☒ Pending
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- ☒ L14: (9477) pulsation or pulsations or pulsating
- ☒ L17: (209643) 111 or 114
- ☒ L20: (706535) current or voltage
- ☒ L23: (24409) 117 near3 120
- ☒ L26: (126) 18 and 123
- ☒ L29: (22386) vane or vanes
- ☒ L32: (1) 126 and 129
- ☒ L35: (34117) vibrate or vibrates or vibrated or vibrating
- ☒ L38: (131488) vibration or vibrations vibrational
- ☒ L41: (148088) 135 or 138
- ☒ L44: (2) 126 and 141
- ☒ L47: (18353) agitate or agitates or agitated or agitating
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- ☒ L53: (25401) 147 or 150
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U	I	PT	P	Document ID	Issue Date	Pages	Title	Current OR	Current Ref	Ref Retrieval	C	Inventor	S	C	2	3	4
1				JP 10092602 A	19980410	7	METALLIC FILM RESISTOR AND ITS MANUFACTURE					MIKAWOTO, NAOMIHO et al.					
2				JP 09058797 A	19970304		AUTOMATIC LIQUID TREATING LINE					OBA, KAZUO et al.					
3				JP 62235714 A	19871015		FORMATION OF MAGNETIC ALLOY THIN FILM AND DEVICE					YOSHIDA, TOSHIMIRO et al.					

[31] Appl. No.	569,124
[34] PROCESS AND APPARATUS FOR ELECTROLYTE EXCHANGE	
[76] Inventor:	Hans J. Hansj. Albrecht, Mobile, Ala.
	Sir 48, Nienberg, Fed. Rep. of Germany, 5300
[11] Patent Number:	5,167,779
[43] Date of Patent:	Dec. 1, 1992
[57] ABSTRACT	
A process and apparatus for obtaining an intensive and	

Current US Cross Reference Classification - CCRX (1):
201/201

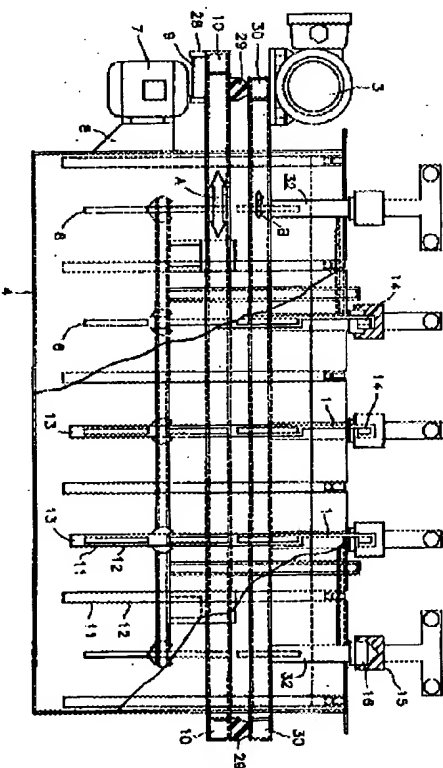
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4,508,396 4/1985	Doll et al.
4,732,844 1/1986	Schwarz
4,883,575 11/1993	Yasuno et al.
FOREIGN PATENT DOCUMENTS	
4433763 1/1975	Japan

(11)	Patent Number:	5,167,779
(45)	Date of Patent:	Dec. 1, 1992

Primary Examiner—John Niebling
Assistant Examiner—Arum S. Phasge
Attorney, Agent, or Firm—Elli, Jacobson, Cohen, Price,
Holzman & Stern

A process and apparatus for obtaining

A process and apparatus for obtaining an intimate and continuous exchange of electricity on the surfaces of workpieces (11, 21) subjected to chemical or electrochemical treatments wherein the exchange is achieved by subjecting the workpieces (11, 21) to strong pulsating oscillation of a frequency of at least 1 Hz and of an amplitude of less than 10 mm, when immersed in an electrolyte. The vibrations are transmitted from an oscillation generator (3) mounted on a workpiece carrier, such as a rack (4, 6) or a rotating dipping drum (5). These high frequency low amplitude oscillations may be combined with low frequency, relatively long oscillations (7, 9, 10, 18), occurring simultaneously. The oscillation generator (3) is arranged on the individual transportable workpiece carriers (1, 2, 4, 6). The workpieces may be bound (11) for plastic parts having through holes (12) or a pourable mass of paste (21).



28 Chalk, 8 Drawing Sheets

United States Patent [19]		(11) Patent Number:	5,755,948
Lazaro et al.		(45) Date of Patent:	May 26, 1998
[54] ELECTROPLATING SYSTEM AND PROCESS	3,926,666	12/19/71	Mazana
[75] Inventor: Adam Ernest Lazaro, Paul Ridger, Peter Heinrichs, Fremont, Chicago, both of Ill.	3,943,388	3/19/76	Clark
	4,682,752	12/19/77	Perkins
	4,930,599	6/19/93	Mazana et al.
	5,435,334	7/1/95	Deis et al.
[73] Assignee: Harwood Line Manufacturing Co.			

Primary Examiner—Kathryn L. Burgess
Assistant Examiner—Eileen Wong
Attorney Agent, or Firm—Twiss C. Allen

1571
ABSTRACT

This invention relates to a system

filled and emended of parts in each

and the parts are cleaned by spraying.

log cell to plating cell. This results in

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED

15 Chalmers, J. D. and J. R. Dwyer

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- L3: (25679) pulsation or pulsations or pulsating

- L4: (390558) 12 or 13

- L5: (88) 11 and 14

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1

METHOD FOR POTENTIAL CONTROLLED ELECTROPLATING OF THIN PATTERNS ON SEMICONDUCTOR WAFERS

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 09/515,414, filed on Feb. 29, 2004, and now abandoned.

BACKGROUND OF THE INVENTION

2

The problem of electroplating metal into integrated circuit features without the formation of voids or seams is the subject of previously filed U.S. patent application Ser. No. 09/410,170, commonly assigned with the present invention. (hereinafter "prior application"), and now abandoned and incorporated herein by reference. The prior application identified previously unrecognized problems with conventional electrolytic techniques and described a four-step method for electroplating metal into integrated circuit features appended to conventional processes. The four phases are: (1) the etching of the surface of the wafer; (2) the etching of the sidewalls; (3) the etching of the bottom; and (4) the electroplating of the metal into the features.

This invention relates generally to electrophoresis methods

for potential-controlled electrodeposition of metal into small

2. Description of Related Art

cross integrated circuits, were
forward by a "Hemacene" ET

444-445.) In damascene processing, an interlayer dielectric

(typically SiO_2) deposited atop a patterned layer containing, for example, a metal via. The photoresist layer is patterned and etched, typically using conventional photolithographic procedures. Nickel is then deposited into features and on the flat field region atop the features, typically by CVD, PVD and then by electrodeposition. The metal layer is typically patterned resulting in the desired metal pattern. Dual damascene processing is similar but makes use of two patterning and etching steps and typically fills features with metal spanning more than one layer in a single metallization step. A more complete description of dual etch and dual damascene processing is found in the literature.

As the art moves towards integrated business environments, it becomes increasingly difficult to define its size.

form electrically conductive metallizations such as wires, contacts and conductors. Techniques for forming such metallizations include physical vapor deposition (PVD), chemical vapor deposition (CVD), plasma enhanced chemical vapor deposition (PECVD) and electroless deposition (also referred to as electroplating or electrodeposition). All methods such as copper electroplating are generally carried out by the formation of stress (mechanical) damage during the electroplating process. The damage is typically able at lower cost while only a limited number of (typical) materials are available for electroplating. The electroplating process requires a power source, a cathode, an anode, an electrolyte solution, and a current. The power source is typically a DC power supply. The cathode is the workpiece to be plated. The anode is a metal of the same material as the workpiece. The electrolyte solution is a solution of the metal ions to be plated. The current is the flow of electrons from the anode to the cathode. The electroplating process is typically carried out in a bath of the electrolyte solution. The workpiece is immersed in the bath. The anode is also immersed in the bath. The power source is connected to the anode and the cathode. The current flows from the anode to the cathode. The metal ions in the electrolyte solution are reduced at the cathode and form a metal coating on the workpiece. The metal coating is the electroplated metal. The electroplating process is typically carried out in a bath of the electrolyte solution. The workpiece is immersed in the bath. The anode is also immersed in the bath. The power source is connected to the anode and the cathode. The current flows from the anode to the cathode. The metal ions in the electrolyte solution are reduced at the cathode and form a metal coating on the workpiece. The metal coating is the electroplated metal.

characteristics of the airtight film. However, there are voids, and due to the superior electrical conductivity

One challenge facing damascene and dual damascene processing techniques is the difficulty of initiating growth of the metals film within recessed features with

processed features leading to a "bottle-neck" shape. Furthermore, the model may be evaluated using programmatic processes, which may include:

plating of metal onto the substrate can result in sealing the top of the feature before completely filling the feature with the metal, creating a void. Voids increase the resistance of the conductor over its designed value due to the absence of conductive material. Also, trapped electrolyte in sealed voids may corrode the metal. This may lead to degraded electrical performance and reliability.

1. ☐ **Yes**
 2. ☐ **No**
 3. ☐ **Don't know**

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Detailed Description Text - DETX (3) :

Detailed Description Text - DETX (4) :

Detailed Description Text - DDTX (6):

